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EVALUATION OF A PROPOSED ALTERNATIVE TO THE AN/TTC-39 SIGNALING--ETC(U)
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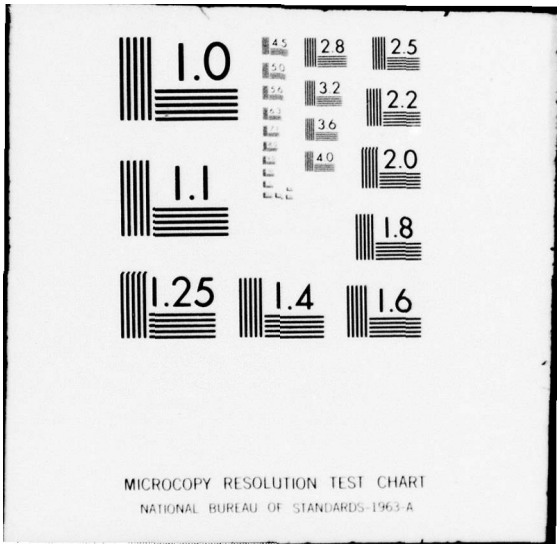
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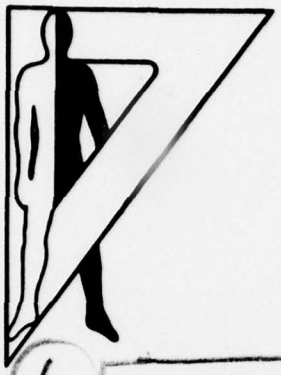

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(6) EVALUATION OF A PROPOSED ALTERNATIVE TO THE AN/TTC-39 SIGNALING TONES SYSTEM

(10) Larry A. Peterson

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This experiment assessed the potential impact of signaling tones simplification on users of the AN/TTC-39 communications system. A significant (33 percent to 50 percent) reduction in learning time for full feature use was achieved over previously tested alternatives which are currently recommended by the manufacturer. The need to reduce overall system complexity was determined through both empirical data analysis and subjective means such as questionnaires. Identification was made of problem tones and tone situations responsible for a significant proportion of subscriber difficulty, and suggestions for remediation were offered.

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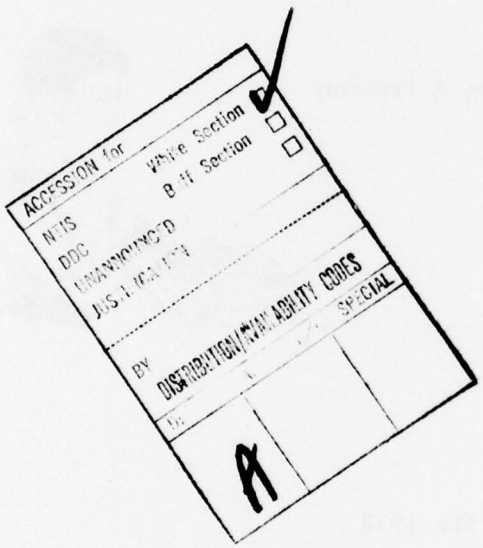

CONTENTS

EXECUTIVE SUMMARY

During development of the AN/TTC-39 circuit switch, the US Army Human Engineering Laboratory (HEL) questioned the ability of the telephone subscriber to effectively use the many different tones provided by the system to identify various call-processing features. An initial study (Reference 2) conducted by this Laboratory at the request of the Multi-Service Communications System (MSCS) Project Office, demonstrated that subscriber performance was adversely affected by the number and complexity of the tones used in the AN/TTC-39 signaling tones set.

Briefings on the results of the study were conducted at the US Army Signal School (USASIGS) at Fort Gordon, GA, and the Tri-Service Tactical Communications (TRITAC) Project Office at Fort Monmouth, NJ. Further research into the problem was authorized by the MSCS Project Office. HEL was also informed by TRITAC that a simplified signaling set had been proposed by the Department of Defense Interoperability Committee (Reference 1) in an effort to standardize the information tones and recorded announcements used in future digital secure switched communications networks.

In order to determine the relative merits of the DOD tone set if applied to the AN/TTC-39 system, the initial HEL study (Tone Study 1) (2) methodology was modified to include the DOD tone set and a second study was run. The questions at issue and primary results of the study are as follows:

1. How does the DOD signaling tone set compare with previously tested (39) signaling sets?

a. A reduction in learning time of approximately 33 percent for basic proficiency and 50 percent for full feature use can be anticipated for the DOD set over current 39 analog/digital sets (see pages 15 and 18, Table 2 on page 17 and Figure 3 on page 11).

b. User acceptance of the DOD set was much more favorable than for the current 39 analog/digital signaling sets, even though the tones comprising the DOD system were almost all identical to tones used in the other systems. This indicates that the complexity and number of the tones currently used with the AN/TTC-39 circuit switch are responsible for learning problems—rather than the frequency and duty cycle of the component tones.

2. In the process of attaining proficiency, what portion(s) of the AN/TTC-39 Analog and Digital signaling sets cause the subscriber the most problems?

a. As in Tone Study 1, the most serious problems came when the participants attempted to use the full-service features of the system.

b. Specific tones and tone situations were identified as presenting significant obstacles to learning the system see page 18 and Appendix A). These were essentially the same as those identified in Tone Study 1 (see page 18 [of this report]), a finding which only reinforces the need for change which was initially hypothesized.

3. What conclusions can be drawn from these studies (Tone Study 1 and Tone Study 2)?

a. The AN/TTC-39 signaling tones system as it is currently envisioned is too complex to permit a desirable level of learning ease and retention.

b. Problem tones and tone situations responsible for a significant proportion of subscriber difficulty have been identified and should be fixed.

c. The AN/TTC-39 circuit switch employs a needlessly complex system of signaling tones. A more desirable alternative exists in the DOD-recommended system, and its adoption would produce significant improvements in subscriber performance.

EVALUATION OF A PROPOSED ALTERNATIVE TO THE AN/TTC-39 SIGNALING TONES SYSTEM

INTRODUCTION

The AN/TTC-39 Circuit Switch, currently being developed for military use, offers its users a number of highly desirable features. Some of those features offered include:

1. Precedence— Five levels of precedence can be assigned to calls. This causes automatic preemption of lower-level calls when all circuits are busy.

2. Communications Security— In certain configurations, end-to-end secure (encrypted) communications are possible.

3. Conferencing— Three types of conferencing are provided: progressive, preprogrammed and broadcast. Progressive conferencing allows the subscriber to incrementally set up his own conference call. With preprogrammed conferencing, the subscriber keys in a 4-digit code and the switch automatically sets up the (preprogrammed) conference for him. Broadcast conference is the same as a preprogrammed conference, except that only the conference originator can talk (one-way communication).

4. Recall— This feature allows subscribers who have a call in progress to access the operator.

5. Call Transfer— This feature allows subscribers to have all incoming calls transferred to another number.

6. Direct Access Service (DAS)— A terminal can be programmed with this service to automatically call a certain number upon going off hook (call initiate).

Unfortunately, this added operational versatility is accompanied by a corresponding increase in the number of tones used to provide information to the user. In addition to the normal dial tone, busy signal and ringback, the new system presents to the user a number of unique call status indicator signals. During the course of a single call, a user could hear (and hence must be able to discriminate among) the following:

1. On going off-hook (picking up the receiver) a subscriber could get either:

a. normal dial tone, indicating that everything is functioning properly and that he should continue his call,

b. call transfer dial tone indicating that his incoming calls are being transferred to another number,

c. lockout tone indicating that his phone was improperly hung up the last time it was used (and must be hung up again before used), or

d. crypto alarm tone indicating that the encryption device in his phone is malfunctioning.

2. On keying in the desired digits a subscriber could get:

a. one of two types of busy signals (see Appendix A, Tone Situations, for a brief explanation) indicating that the party he desired to call could not be reached,

b. a busy signal indicating that the service requested (e.g., if placing a conference call) was not available,

c. an error tone, indicating that the digits keyed in were not acceptable to the system, or

d. a ringback, which could be one of three different types (analog, digital, or converter) depending on the instruments used to transmit and receive the call.

3. During a conversation with the called party, a subscriber could hear:

a. a preempt tone, indicating that a call of higher precedence had preempted the call,

b. a preempt tone followed by a line busy tone, meaning that the other party in conversation was the desired object of the preemption,

c. non-secure warning tone (an intermittent background signal) indicative of a non-secure line, or

d. conferee disconnect tone (if in a conference call)

4. On an incoming call (e.g., when the phone rings) it would be possible on lifting the receiver to hear:

a. broadcast conference notification tone, or

b. preprogrammed conference notification tone.

Further complicating this already difficult process is the fact that reception of specific tone situations is also dependent on what type of instrument (e.g., analog or digital) is being used! This problem evolves from the hybrid nature of the AN/TTC-39 switch, which must be able to handle existing analog communication devices as well as the newer digital processing equipment necessary for secure (encrypted) voice transmission and reception. In many situations, a subscriber will have to know and use both types of instruments (analog and digital telephones) with varying degrees of frequency. The initial concern within the military as to the number and composition of signaling tones to be used led to an initial experiment in which the systems were examined using military personnel as test participants.

A complete analysis of the initial experiment can be found in HEL Technical Memorandum 30-76 (Tone Study 1), but a brief summary of the results can be made by reviewing the data provided below (page numbers refer to location of data in original report).

Tone Study 1 Summary:

1. How long will it take a subscriber to become proficient in the use of the signaling system as specified?

a. The basic tones and services can be learned in approximately one workin[illegible] (see pages 21-23).

b. Learning to use the full spectrum of tones and services available takes a considerable amount of additional time (pages 23-24), possibly weeks, depending on frequency of use of the feature involved or of system perturbation.

c. Ability to learn the signaling system is highly related to subscriber IQ; i.e., the higher the IQ, the more quickly a subscriber can learn to use the system (pages 17, 20).

2. In the process of becoming proficient, what portion(s) of the signaling system cause the subscriber the most problems?

a. The main problem was caused by attempting to use the full-service features of the system, which included broadcast-conferencing features, progressive conferencing, preprogrammed conferencing, call-transfer terminal redesignation, operator recall, and numerous other features with their associated tones. The total number of possible interrelationships among tones and features proved to be an almost insurmountable obstacle to learning the system rapidly (pages 20-25).

b. Certain specific tones were definitely identified as needing change or, in some cases, elimination (pages 20, 24).

c. Certain other tones were identified as presenting impediments to effective learning (pages 20, 24).

3. Having become proficient, how well does the subscriber retain this knowledge after extended periods of disuse?

Following a period of training during which the participants were taught how to operate the system and all of its features, there was a 30-day period without practice, then they were retested. Results of this test (pages 21-24) indicated that participants were still able to use the basic features; however, relearning the full-service features required more than the equivalent of a full day's practice. The problems that this amount of delay could cause in a combat situation are rather obvious.

Recommendations were offered for changing specific tones and for generally simplifying the system (pages 24-26).

Subsequent to the publication of the results of this initial study, concern for the ability of the average subscriber to effectively use this system grew. Briefings were given within the military community for the purpose of explaining the results and conclusions of the study. As a result of the interest generated (and in an effort to find a way of making the system more usable), a second major study was initiated. This report covers that second study.

The purpose of the second study was twofold—first, to validate the conclusions of the initial study with regard to defining which tones represented the greatest problems to the user, and also to attempt to test a simplified method of guiding the subscriber through the calling process. This alternate method of organizing and reducing the number of signaling tones and recorded announcements was suggested by the final report of a Department of Defense committee on communications interoperability, which had apparently foreseen the problem. The present design of the AN/TTC-39 does not incorporate any of the recommendations of this group, but results of

the first experiment indicated the need for some kind of simplification of the calling process. It was hoped that use of a less complex signaling tone system would significantly increase both subscriber efficiency and satisfaction with the system while at the same time reducing the possibility of errors.

The objectives of the second study were to replicate the results of the first tone study and to attempt to validate an alternative method of signaling tone presentation based on the guidelines offered in the DOD interoperability report.

METHOD

Subjects

Twenty-one military personnel from various companies at Fort Meade, MD, were used in this study. They had normal hearing and tone acuity. General intelligence was established through use of the Otis Quick-Scoring Test of Mental Ability (high school, Form A), and the range of IQ scores was 79 to 115. The mean score was 96. Participants were matched by tested IQ level and randomly assigned to one of the three test groups (analog, digital, or DOD). Each group (A, D or DOD) contained six participants, and three of the group of 21 were randomly selected for use as reserves in the event of unavailability of a selected test participant. These reserves were not used, since the group of 18 initially selected personnel were available for the entire test cycle.

Apparatus

The guiding concept used in design of the experimental apparatus was to introduce as much realism into the simulated call process as possible. The principal apparatus used in the study is illustrated in Figure 1. The general apparatus arrangement is illustrated in Figure 2.

The signaling tones were stored on a Honeywell Model 5600B 14-channel Analog Data Recorder, which was used in the playback mode during testing. Each participant used a TA-341 Telephone Set to initiate and receive simulated calls. Although the tones were presented to the participants on a self-initiated basis, the actual tones to be presented were controlled by the experimenter through the use of the Tone Controller. For example, the participants were told to initiate a call to telephone number 601. The experimenter would set the "hook circuit switch" to Channel No. 1 and the "key circuit switch" to Channel No. 4.

As each participant went off hook, an electronically operated switch in the Tone Selector closed the "hook circuit," which played back a continuous 425-Hz tone (dial tone). The participant then keyed in the digits 601. The keying of digit "6" caused the "hook circuit" to open, cancelling the dial tone. Keying the digit "1" closed the "key circuit," which played back 570 Hz, 2 seconds on, 4 seconds off (normal ringback tone). Replacing the receiver on its cradle opened the key channel, cancelling the ringback tone.

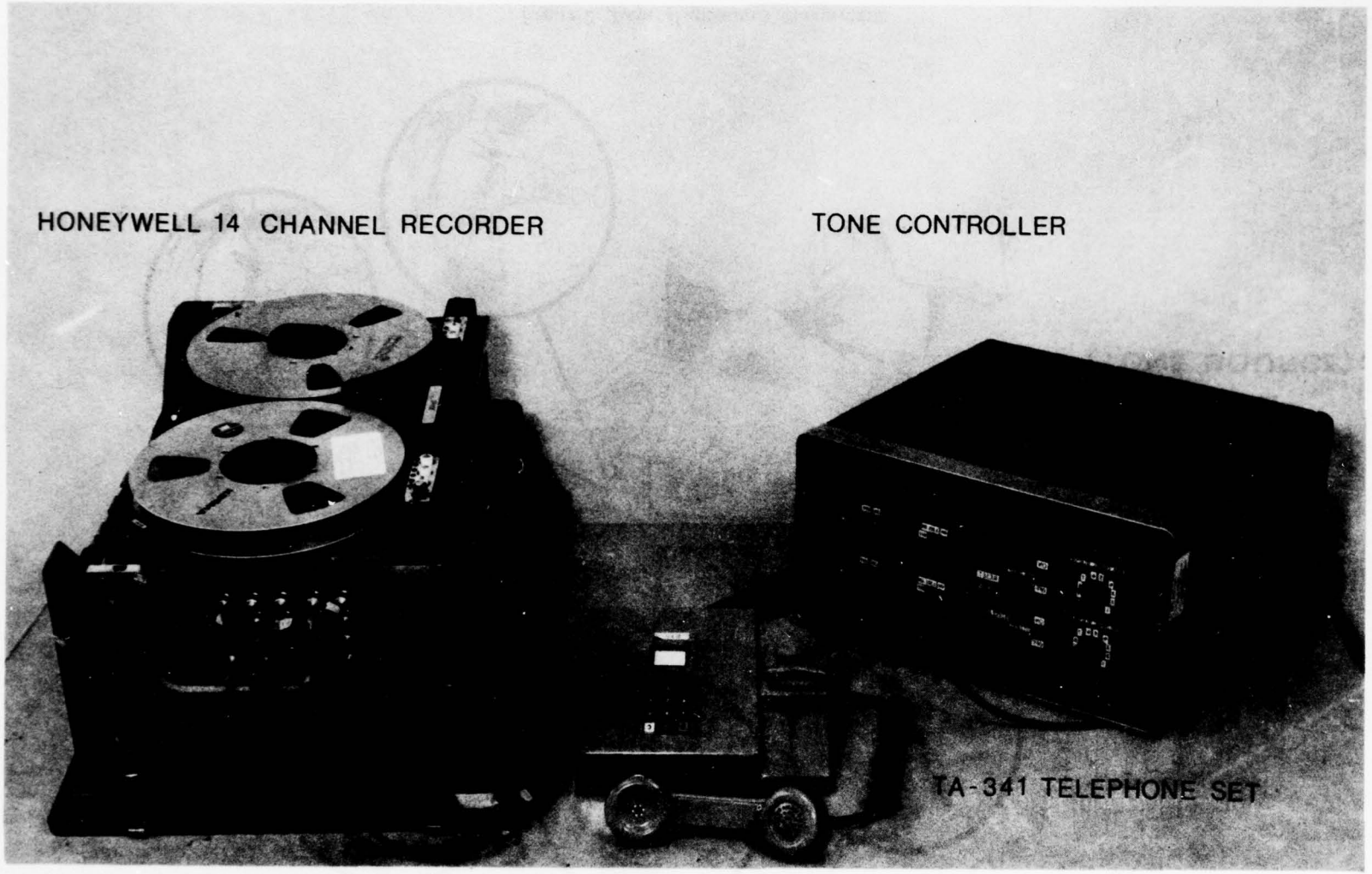

Figure 1. Principal apparatus.

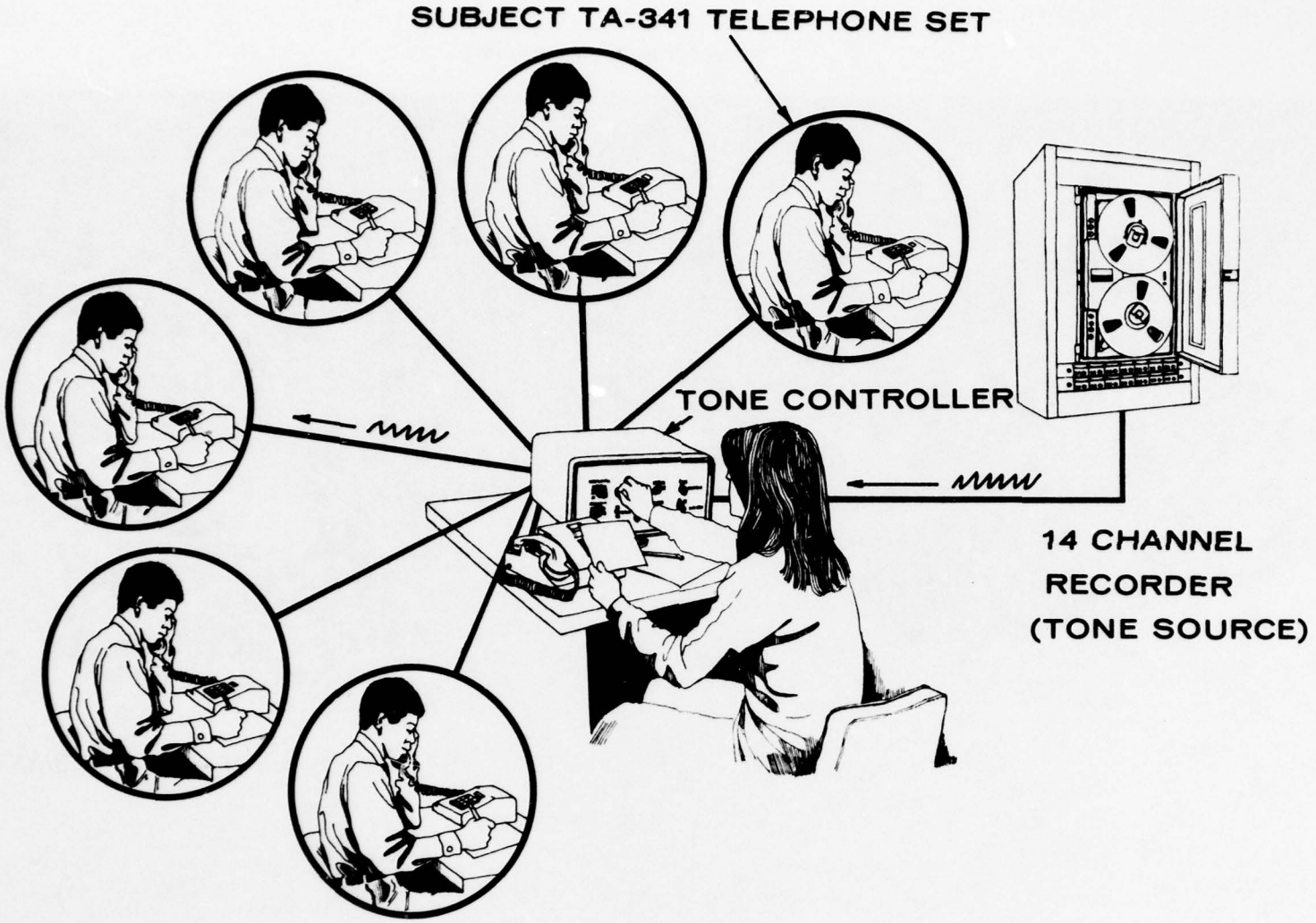

Figure 2. General apparatus arrangement.

Procedure

General procedures followed were virtually identical to those of Tone Study 1. The basic questions of concern were the periods of time required to attain proficiency in the use of the respective systems and the identification of specific problem areas among the various tone situations. Two conditions, basic (b) and full service (F), were used within each test group.

The test groups of six participants remained intact throughout the three phases of testing (basic, full service and the transfer conditions). Progression of the testing procedure is outlined in Figure 3 below. The basic conditions included those tone situations which resulted from the processing of a normal party-to-party phone call (e.g., dial tone, busy signal, ringback, etc.), while the full service condition included all features available to a subscriber (e.g., conferencing, call transfer, various conference notifications, etc.). The transfer condition consisted of taking the six participants fully proficient in the Full Service Analog condition and testing them on the Full Service Digital Tones, and similarly testing the six proficient participants in the Full Service Digital Condition on the Full Service DOD tones. The first transfer condition would simulate the condition which may be expected to occur as the digital system is "phased in" to the current analog system and its users. The second transfer condition simulates the situation which can be expected should the DOD system be adopted subsequent to the use of the currently proposed system. The purpose of both transfer conditions was to permit identification and evaluation of potential problem areas during subsequent permutations in the AN/TTC-39 system. Distribution of signaling tone situations as a function of conditions is shown in Table 1.

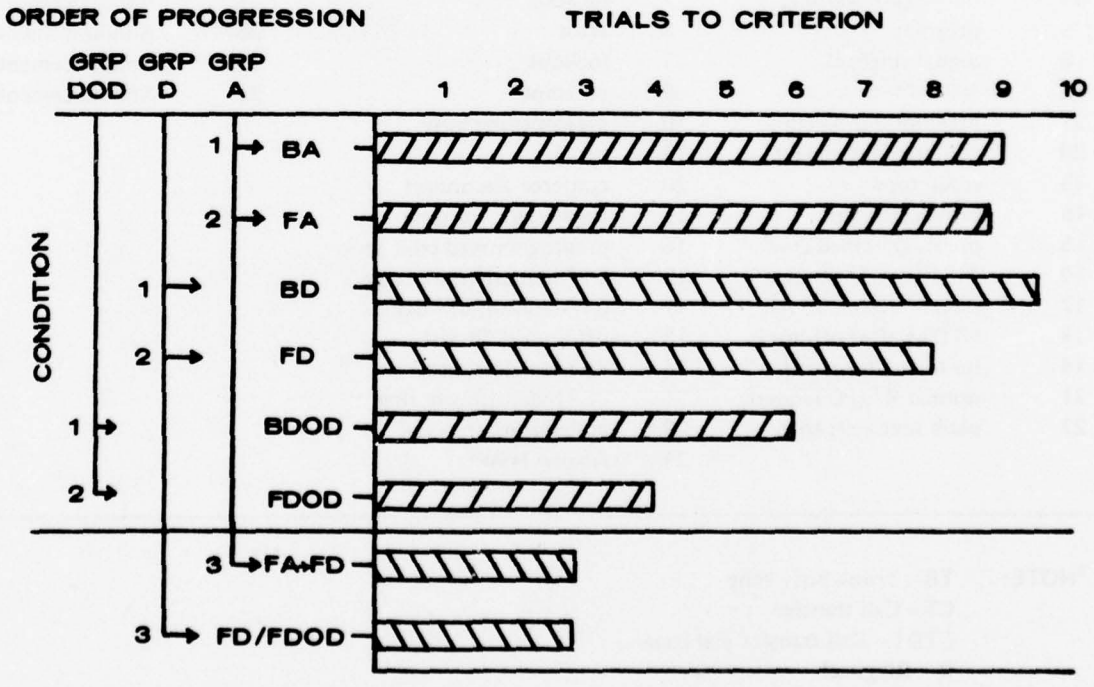

Figure 3. Trials to criterion by groups and conditions.

TABLE 1

Distribution of Signaling Tones As a Function of Condition

Situation Number	BD	Situation Number	BA	Situation Number	B-DOD
1	dial tone	1	dial tone	1	dial
4	normal ringback	4	normal ringback	4	normal ringback
5	converter ringback	5	converter ringback	2	line busy
2	line busy	2	line busy	8	error
8	error	3	trunk busy	11	NSW
11	non-secure warning	8	error	25	conf notif
9	preempt	7	lockout		
6	digital ringback	9	preempt		
12	alarm tone	10	preempt/line busy		
	FD		**FA**		**F-DOD**
1	dial tone	1	dial tone	1	dial
4	normal ringback	4	normal ringback	4	normal ringback
5	converter ringback	5	converter ringback	2	line busy
2	line busy	2	line busy	8	error
3	trunk busy	3	trunk busy	11	NSW
8	error	8	error	23	PTA
11	non-secure warning	7	lockout	25	Announcement
9	preempt	8	error	26	Announcement
6	digital ringback	7	lockout	27	Announcement
12	alarm tone	9	preempt	28	Announcement
22	preempt during conf	10	preempt/line busy		
20	conferee disconnect	13	recall		
13	recall tone	20	conferee disconnect		
15	broadcast conf	15	broadcast conf tone		
16	preprogrammed conf	16	preprogrammed conf tone		
19	TB after CT[a] request	19	CT[a] request/trunk busy		
17	CTDT[a] after CT[a] req	17	CT[a] request/CT[a] dial		
18	CTDT[a] after off-hook	18	off-hook/CT[a] dial		
14	no tone after recall	14	no tone after recall		
21	normal R[a] (PC request)	21	PC[a] request/norm ring		
23	plain text alert tone	22	preempt during conf		
		24	Analog NSW[a]		

[a]NOTE: TB– Trunk busy tone
CT– Call transfer
CTDT– Call transfer dial tone
R– Ringback
NSW– Non-secure warning
PTA– Plain text alert tone

This arrangement of basic and full-service conditions simulated subscribers first being subjected to the basic tone situations and later, after having gained experience with the system, moving on to use the full services on the instrument. This test design was considered realistic for the full-service subscriber, who would first become familiar with the basic services before attempting to use any of the more sophisticated features.

The first training period stressed familiarization with the AN/TTC-39 system, with test objectives and procedures, and with call-progressing features and procedures. Participant groups received training in call-processing procedures in their respective basic condition only. Call-processing-procedure training was presented in the form of detailed directory-type written instructions (Appendix B).

Participants also had an abbreviated set of written instructions (Appendix C). The instructions described the procedures for placing the different types of calls, and the tones that the participant might hear during those calls. Throughout the testing phases the participants had access to both sets of instructions.

A question-and-answer period occurred just prior to the full-service-condition test period of Phase I testing. At this time, the participants were encouraged to familiarize themselves with the call-processing procedures of their respective full-service conditions. The experimenters answered any questions the participants posed about test procedure or call-processing features.

Each testing interval (basic or full service analog, digital or DOD condition) consisted of a potential maximum of 25 test runs for each group, separated by rest periods during which the other two groups were sequentially tested. Each test run consisted of a series of simulated calls, both incoming and outgoing. The test runs were constructed so that the participant experienced each tone situation once during each test run within the condition being tested. Dial tone had to be repeated more than once in order to develop the scenario sufficiently to handle the other situations. Each complete call-process situation (e.g., off hook/dial tone/line busy tone/on hook) was printed on a separate 5x7" index card so the tone situations could be randomized for each separate test run. This was done to minimize the participant's recognition of run patterns.

The procedure followed for each simulated call in the test runs was basically the same. The participants were directed to place or respond to some specific simulated call. The participants were given the opportunity to review the abbreviated and/or detailed written instructions on the call-processing features. During the call process, the participants would receive a signaling tone. At this point, the participants would choose an answer from their list of possible answers (Appendix D) and mark it on their answer sheets (Appendix E). After all participants had put down their answers, the experimenter told them the best answer. This form of reinforcement was considered analogous to the "experienced-user advice" usually available to the novice subscriber. After all discussion on the "best answer" was completed, the participants would wait for further instructions from the experimenter.

At the end of Phase II (e.g., completion of Full Service testing), after all testing had been completed, a questionnaire was given to each of the participants (Appendix F). The purpose of the questionnaire was to yield information about the participants' subjective feelings: effectiveness of the tones, both as a group and singly; preference for either the abbreviated or the detailed instructions, and why; and, finally, identification of difficult tones.

A participant was considered to have become proficient in the basic testing condition when he scored 94 percent or more correct on any two consecutive test runs. When a participant did reach that criterion, he was removed from any further testing in that test interval. Participants

who completed their basic-condition testing before the maximum number of test runs were retested at the beginning of the full-service-condition testing until they reached the 94 percent criterion. This was done to ensure that all participants started the full-service-condition testing at the same minimum level of proficiency. Further, in order to be considered proficient in the full-service condition, a participant had to score 97 percent correct on any two consecutive test runs.

Three levels of response quality were used to allow the participants to express incremental advances in learning. The three levels were defined as follows:

- Level One: acceptable but less-than-satisfactory responses. At this level a correct response demonstrated that the participant knew the correct basic reaction to a tone, but had no real understanding of its meaning.

- Level Two: satisfactory responses. At this level, a correct response demonstrated that the participant knew the correct tone reaction and its general meaning.

- Level Three: more than satisfactory responses. A correct response at this level showed that the participant understood some of the signaling system nuances that were not crucial to subnumber effectiveness, but which were beneficial.

Examples of the three levels of response are illustrated in Figure 4.

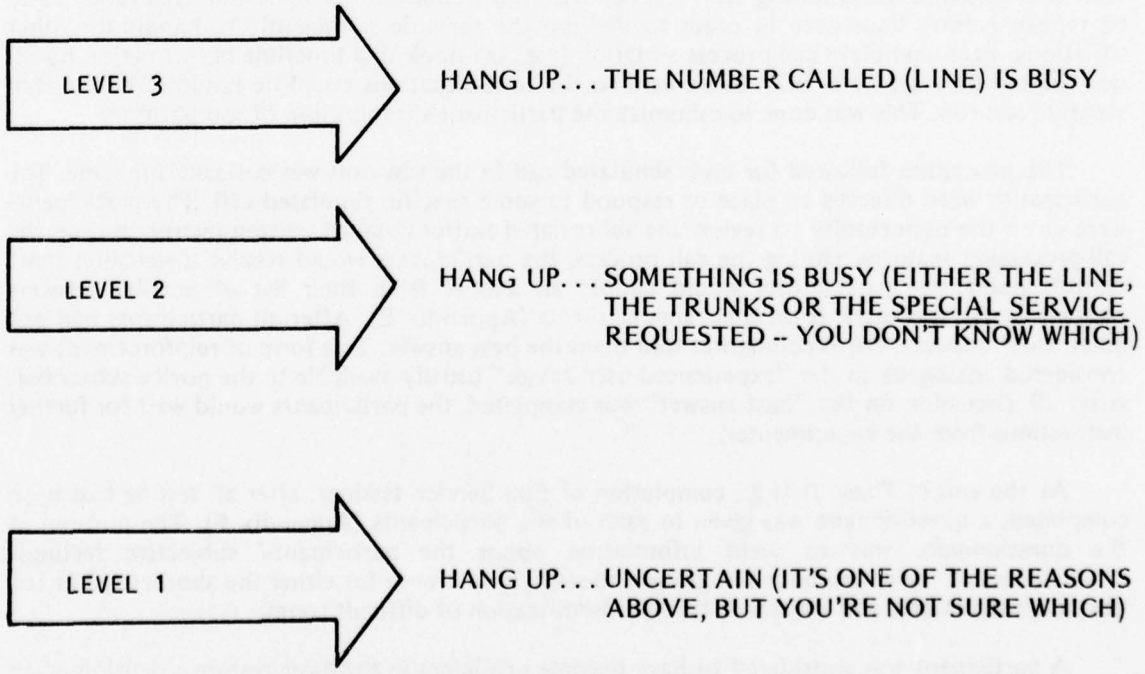

Figure 4. Levels of response.

The scoring criteria are illustrated in Figure 5. The weighting increment between levels two and three was less than between levels one and two. This unequal-weighting concept was in keeping with the definitions applied to the levels. Specifically, it was considered that participants should attain at least level two in all situations to demonstrate acceptable performance. This would not occur with equal weighting increments; e.g., a level-three response would counterbalance a level-one response. Instead, using the unequal-weighting system, it took about three level-three responses under both basic conditions (12 points) and five level-three responses under the full-service conditions (11 points) to counterbalance one level-one response (5 points). The difference in level-three weighting was applied to compensate for the difference in number of tone situations between the basic and full-service conditions. The result of these weighting procedures was that testing continued until overall level-two performance was achieved.

RESULTS

The improved signaling system (DOD condition), suggested by the DOD Interoperability Report and incorporating fewer tones and more simplified call structuring, provided a significant ($p < .01$, two-tailed t test) improvement over both analog and digital conditions. The time to learn full service DOD condition was approximately half that of either analog or digital (4.00 versus 8.83 and 8.00 respectively), as shown in Table 2, and the time to learn the basics of system operation was reduced by about one-third. The treatment effect was significant, $F(2.30) = 8.99$, $p < .001$. For the complete ANOVA summary, see Table 13G in Appendix G.

User acceptance of the improved system was extremely good. Comparison of Tables 1G through 3G in Appendix G shows much higher ratings (on a 6-point semantic differential scale) of tones in the DOD group than for either of the other two groups—a particularly significant finding in light of the fact that the tones used in the DOD system were identical to those of the digital system. Since there was no difference in tone composition, performance improvement on the DOD system can most probably be attributed to the reduction in the number and complexity of tone situations. For example, line busy and trunk busy tones in analog and digital groups were rated between 3.5 and 4.6 in terms of learning difficulty by the participants (a rating of 1 equals "very difficult," 6 equals "very easy" on the semantic differential scale used in the questionnaire), while the DOD group rated the equivalent tone at 5.5—indicating that the test condition, rather than the tone itself, was the cause of their difficulty.

Specific problem areas were also pointed out during analysis of test data and questionnaires. Tone situation number 16 (preprogrammed conference notification tone), for example received ratings of 2.33 and 2.50 from the digital and analog groups respectively. Analysis of the Summary Data Table 4Ga shows a mean correct percentage of 77.8 over all trials. Further investigation using Table 5Ga, reveals that the mean percentage correct by condition was 82.2 and 68.6 for Full Analog (FA) and Full Digital (FD) conditions respectively. Using this type of data correlation, and questionnaire results and tables, led to the identification of individual tones which presented obstacles to the user. This mix of both objective and subjective data was useful in providing an effective means for cross-validation of test results.

Tone situations which caused problems in all test conditions can be readily identified in Appendix A, which shows the tone situations by number and offers a brief explanation of each. To the left of each tone situation number is the value representing the mean percent correct for each overall presentation. Most readily identified as potential sources of subscriber error are preempt, recall, call transfer notification, plain text alert, conferee disconnect and call transfer

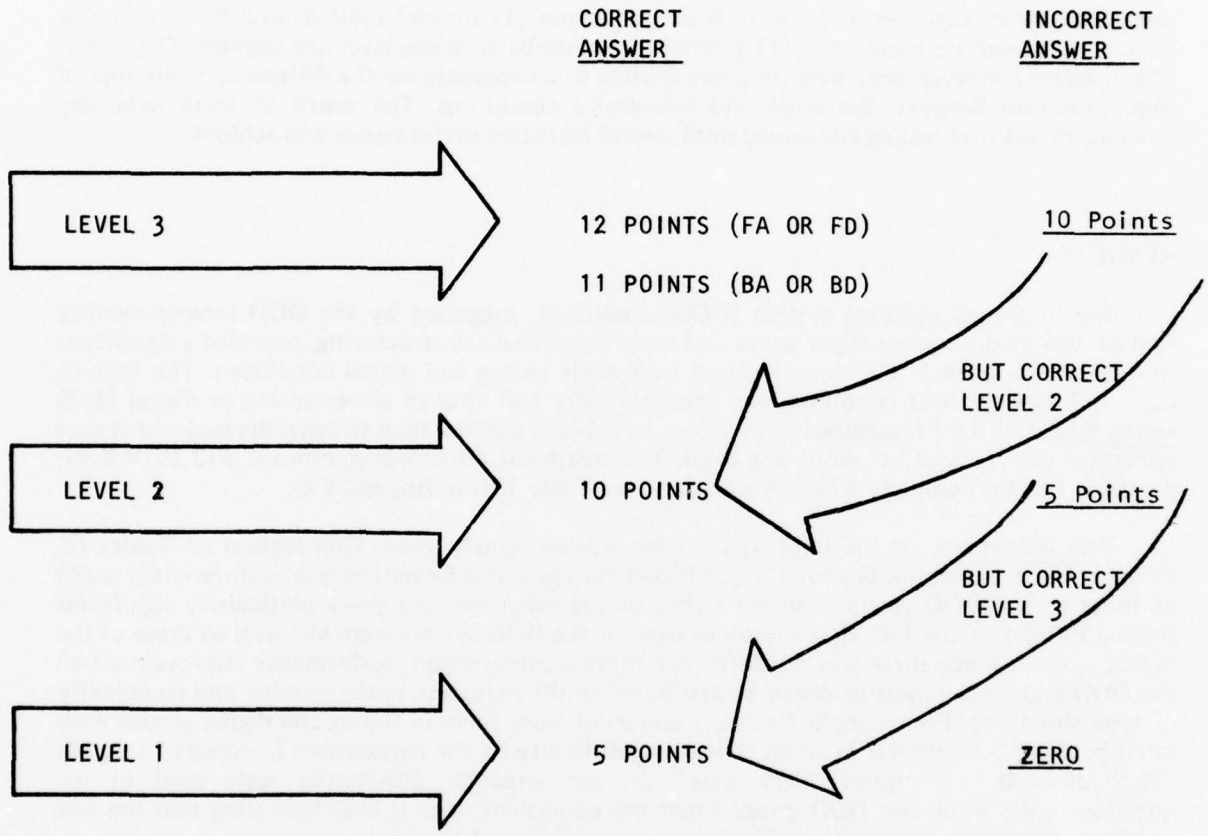

Figure 5. Scoring criteria.

TABLE 2

Trials to Criterion As a Function of Condition and Level of Treatment

Condition	Mean Trials	Standard Deviation
BA	9.00	2.76
FA	8.83	3.37
BD	9.50	2.17
FD	8.00	2.19
BDOD	6.00	3.22
FDOD	4.00	.63
FA/FD	2.83	.75
FD/FDOD	2.83	.75

Summary of ANOVA[a]

Source	SS	df	MS	F
A	117.72	2	58.86	8.99[b]
B	13.44	1	13.44	2.05
AxB	5.39	2	2.70	.41
S/AB	196.34	30	6.55	-
	332.89	35		

[a]Does not include transfer conditions (FA/FD, FD/FDOD)

[b]$p < .001$

dial tones. These tone situations were more than one standard deviation away from the mean correct value, indicating that a significant potential for subscriber error exists if these tone situations are not modified.

Further interpretation of this and other related tables should be tempered by several factors, most notably:

1. The Summary Table for tone situations (Appendix A) is a collapsed matrix, showing all presentations over all trials. Subscriber performance will vary as a function of whether he is using the analog, digital, or (if adopted) DOD system of signaling tones and also whether he is just learning the system (basic condition) or is an experienced subscriber using its full potential (full service condition). For example, as shown in Table 6A (Appendix A), rows two and three, collapsed matrix: analog, digital, DOD tone situations such as numbers 8, 10, 25 and most notably 21, 24 and 31 proved to be very difficult to learn initially. Since mastery of the AN/TTC-39 system will probably require a considerable measure of initial confidence, tones which are difficult to learn initially provide the best candidates for immediate repair.

2. Error probabilities for a sequential process such as a telephone call (which requires a number of correct choices in a specific order) are multiplicative in nature, and the probability of completing a call sequence is a function of the level of difficulty of each tone situation multiplied together. That is, the estimated probability of completing a call sequence in full service digital condition involving dial tone (situation no. 1), ringback (no. 6) and non-secure warning tone (no. 11) would be 90.4 percent x 78.8 percent x 87.1 percent or 62 percent. In a similar manner, general probabilities for successful completion of a given call sequence can be computed for different tone situations in various conditions.

3. Caveat. All interpretations made from these data are to be considered as indices of general performance trends only. The small sample size per group (N = 6) leads to an inevitable increase in variance of scores, and the data should be viewed as representative but not definitive in terms of actual projected user performance.

DISCUSSION

In terms of both of the purposes outlined for this study (validation of Tone Study 1 data and evaluation of a proposed alternative signaling tones system for improved user performance), the data were clearly of value. Tone situations identified as potential problems in the first tone study (e.g., numbers 9, 15, 16, 20 and 22) continued to plague the system users. Questionnaire analysis and informal interviews indicated that the causal factors in tone problems identified by the participants were the same for this group as in the Tone Study I group.

Conference notification tones, for example, still caused problems because the 1-second burst of tone was triggered as soon as the participants picked up the phone, and in a number of cases this did not provide sufficient time for the participant to get the receiver up to his ear. Preempt and conferee disconnect tones were identified by this group (as well as the Tone Study I group) as being too similar in sound to permit discrimination, and tone situation number 14 (no tone after operator recall request, indicating that the service requested was busy) still proved perplexing due to its absence of discernible feedback.

Also of considerable interest was the performance of the users of the simplified (DOD recommended) system of signaling tones. By eliminating ambiguous and/or unnecessary tones and substituting recorded announcements for purposes of clarity whenever possible, a system was developed which proved in testing to be easily learned and highly acceptable in terms of user preference.

Scoring on the semantic differential scale used in Table 3G, indicates high user acceptability for tones which in other conditions represented problems to the user—indicating that the context and not the tone itself was more responsible for learning difficulty. Indeed, the only two tones which were rated below 5.0 on this scale were error tone and plain text alert tone, and their respective ratings of 4.50 and 4.16 are still well above the minimal level of user acceptance. By every criterion of evaluation, the DOD recommended system emerged as clearly superior to the other.

Additionally, analysis of the transfer condition (in which participants reaching criterion in full service digital use were "switched" to the DOD system to evaluate change-over effects) noted in Appendix G, Table 12G, indicates that little difficulty can be anticipated in learning the DOD system after the digital system has been mastered. These data would indicate that implementation of the DOD system even after the AN/TTC-39 system is fielded, will present little difficulty to the subscriber in terms of relearning the calling process.

CONCLUSIONS AND RECOMMENDATIONS

1. Validation of the initial experimental data has been obtained. Recommend strongly that tone situations identified as problems in these data be given serious consideration for remediation/ replacement as necessary and appropriate.

2. Specific problem areas have been identified. Those tone situations most in need of change can be prioritized as to effect on overall user performance as well as general cost- effectiveness of proposed modifications.

3. The need for change is clear. Degradation of user performance and system acceptance has been sufficiently quantified to permit an evaluation of overall system effectiveness. The AN/TTC-39 as it is currently configured will present significant and lasting problems to the intended user. Moreover, most of the identified problem areas are avoidable through the use of fewer and less complex signaling tone situations. It cannot be overemphasized that elimination and simplification of tone situations is desired, a process whose implementation should present no significant software problems to the manufacturer (some hardware additions to contain the increased quality of recorded message). The potential benefits to the user are easily discernable.

4. A more desirable and effective alternative exists. The DOD system, as modified by the US Army Human Engineering Laboratory to incorporate some recent changes in AN/TTC-39 signaling technology, provides equivalent service to the user while at the same time reducing time to learn and user error rate. Probability of user acceptance is increased and operational effectiveness is enhanced through simplification of the signaling tone situations and substitution of recorded announcements in some cases. The DOD system is strongly recommended to be made the basis for a standard operational signaling tone system for the AN/TTC-39 and subsequent systems.

5. There is a need for a standardized approach to signaling tones in DOD communication use. Further research is needed to determine the best way to pass on the most information to the user of an electronic communication system. A unified, coherent and standardized method is needed to provide an optimal mix of signaling tones and announcements for new communications systems, given the intended mission and projected cost as well as the complexity of information needed and other external and internal constraints such as memory size and interoperability with other existing and projected systems.

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APPENDIX A

TONE SITUATIONS

TONE SITUATIONS

X(A)		
91.5	1.	dial tone - wait for called party to answer
86.4	2.	line busy - hang up, terminal called is in use (wait before calling again)
86.4	3.	trunk busy - hang up, system cannot complete call (can call back immediately)
82.6	4.	normal ringback - wait for called party to answer
82.0	5.	converter ringback - wait for called party to answer
69.9	6.	digital ringback - wait for called party to answer
91.2	7.	lockout tone - phone was not hung up properly (hang up)
72.7	8.	error tone - dialing or other error made
65.0*	9.	preempt tone - your call has been preempted by a call of higher precedence
82.5	10.	preempt tone (9) followed by line busy (call preempted, you are not the desired party.
90.1	11.	Digital non-secure warning tone - line is not secure (no classified disclosures)
81.7	12.	alarm tone - internal failure
57.9*	13.	recall tone - recall service available, wait for operator to answer
75.4	14.	no tone after recall request, indicating service requested is not available
77.9	15.	broadcast conference notification tone - incoming conference call
77.8	16.	preprogrammed conference notification tone - incoming conference call
60.7*	17.	call transfer dial tone (after call transfer request) - service available

(Continued)

TONE SITUATIONS (Continued)

67.6*	18.	Call transfer notification tone (received instead of dial tone)
90.6	19.	trunk busy signal (3) after call transfer request (service requested is not available)
52.9*	20.	conferee disconnect tone (a conferee has dropped out of conference bridge)
86.5	21.	ringback (4) after requesting a preprogrammed conference call (service is available)
74.3	22.	preempt tone (9) during conference call
90.4	23.	analog non-secure warning tone
60.5*	24.	plain text alert tone
90.0	25.	conference notification announcement (recorded message)
87.1	26.	precedence exceeded announcement (recorded message)
100.0	27.	restricted area announcement (recorded message)
98.4	28.	unassigned number announcement (recorded message)
98.4	29.	(number called) out of service announcement (recorded message)
82.3	30.	dial tone (1) after call transfer request (service is available)
80.0	31.	busy signal (2) indicating that your call has been pre-empted
91.9	32.	ringback (6) indicating recall service is available (wait for operator to answer)
100.0	33.	ringback (6) indicating preprogrammed conferencing (wait for called parties to answer)
93.5	34.	busy signal (2) indicating preprogrammed conferencing service is not available

(Continued)

93.3 35. busy signal (2) indicating that call transfer service is not available

$\bar{X}$ 81.98
σ 12.48

A) mean percent correct responses for this tone situation for all presentations in all conditions.

*) difficult to learn ($>$ 1 σ), i.e. greater than one standard deviation below mean item difficulty (81.07)

(Concluded)

APPENDIX B

DETAILED INSTRUCTIONS
(Representative Example)

DESCRIPTION OF AN/TTC-39 CALL PROCESSING FEATURES

1. NORMAL CALLS– To place a normal call, lift the handset (receiver off hook (cradle). Listen for dial tone, then key in the desired digits. If the desired party is not busy, you will hear the ringback tone until they answer. There are three different types of ringback:

a. Normal– The telephone on the other end is a different type of phone (e.g., on analog phone).

b. Converter– The terminal on the other end is a special type of switching equipment. The converter ringback tone will be lower in pitch than the normal ringback.

c. Digital– The telephone on the other end is the same as yours, a digital (secure) phone capable of "coding" voice communication so as to prevent interception of classified information by the enemy.

If the desired party is engaged in a call already, you will hear line busy tone, which is similar (in pitch) to the dial tone but is an interrupted tone. If the network is blocking your call you will hear trunk busy tone, which is similar to the line busy tone but "faster." In either case hang up and try again later.

2. PRECEDENCE CALLS– Phones are capable of being assigned to five levels of precedence: routine, Priority (P), Immediate (I), Flash (F), or Flash Override (FO). Routine is the lowest level and is handled as a normal call. To initiate a higher precedence call, you lift the handset. After you hear dial tone you first key in your precedence digit (P, I, F, or FO), followed by the number for the desired party. What happens with calls of a high precedence is that they will preempt other calls in progress of a lower precedence as necessary. If you are in the middle of a call and preempted in order to receive a higher level call, you will hear a short burst of preempt notification tone and then be connected to the higher precedence caller. If you are in the middle of a call and preempted completely (connected to no one, you are not the desired party) you will hear a short burst of preempt notification tone followed by silence. The proper response is to wait long enough to make sure that you are not the desired party and then hang up.

3. RECALL– If you want operator assistance during a call (Recall), you key the digit "CR." If operator assistance is available, you will hear recall response tone after you key "CR." You should then wait for the operator to answer. If operator service is unavailable, you will get no recall response tone after keying "CR."

4. PROGRESSIVE CONFERENCE CALLS– A progressive conference call is based on the technique whereby a subscriber calls each conferee in sequence, waiting and verifying the success or failure of connecting each conferee before calling the next one.

To set up a progressive conference call, lift the handset. After dial tone, key the digit "C" followed by the first conferee's number. For each additional conferee key "C" for dial tone and key the conferee's number. If a conferee does not answer, key the digit "R" for release.

5. PREPROGRAMMED CONFERENCE CALLS– A preprogrammed conference call allows select subscribers to ring up a pre-established list of conferees simultaneously:

To set up a preprogrammed conference call, lift the handset. After dial tone, key the digit "C" followed by the specified 3 number code. Conferees are notified of the incoming preprogrammed conference call by a burst of conference notification tone received just after lifting their receiver off hook. Unanswered conferees are automatically disconnected after 1 minute as indicated by conferee disconnect tone. Conferee disconnect tone is also returned when any conferee hangs up (goes on hook).

The conference notification tone consists (after you "answer" the ringing phone), of a 1-second burst of two tones presented simultaneously. The appropriate response is to remain silent and wait until the conference initiator begins the conference.

The conferee disconnect tone consists of a 1 second burst of two tones presented simultaneously.

6. BROADCAST CONFERENCE CALL– A broadcast conference call allows select subscribers to ring up a pre-established list of conferees simultaneously. This service is similar to preprogrammed conference except that: (a) conferees are notified of an incoming broadcast conference call by a unique broadcast conference notification tone, and (b) conferees are not capable of conversing with the conference originator.

The broadcast conference notification tone consists of a 1-second burst of tone. The appropriate response is to remain silent and wait for the broadcast message.

7. CALL TRANSFER SERVICE– This service allows subscribers to program their telephones so that all incoming calls are automatically transferred to some other designated number. To initiate call transfer, lift up the receiver. After dial tone, key in the digits "3R." You then hear call transfer dial tone if that service is not full. You then key in the number where you want your calls transferred to and hang up. If, after keying in "3R" you hear trunk busy, this means that call transfer service is full.

The call transfer dial tone consists of a continuous signal.

If you attempt to place a call from your phone after you have initiated call transfer, you will hear call transfer dial tone in place of regular dial tone when you lift the receiver off the hook. This is to remind you that you will receive no incoming calls until call transfer is reversed. You may still, however, make outgoing calls with call transfer in effect on your instrument. To cancel this feature, key "3R" and then your number. (This must be done from the instrument at which it was initiated.)

8. ERROR TONE– If you attempt to use any call processing feature which is not authorized on your phone, or key an improper series of digits you will receive error tone in return.

The error tone consists of a tone which shifts frequencies at 1/8-second intervals. This is not a "sliding" shift but rather a distinct presentation of two separate tones, changing every 1/8 second.

9. SECURE CALLS– Secure calls can be made from your digital telephone under normal circumstances. If, however, your call is placed to a non-secure end instrument, both parties will hear a short non-secure warning tone emitted every 8 seconds continuously during the call, to warn you not to discuss any classified information. Also, if the security device servicing your digital telephone is not functioning, you will hear an alarm tone. In that case hang up and wait for repairs to be completed.

The procedure for originating a non-secure call from your phone is to:

(1) Go off hook, dial desired number after hearing dial tone.

(2) After connecting you with a non-secure phone, but before you can speak to the party on the other end, the system will emit a Plain Text Alert Tone.

(3) Continue with your call and begin conversation. In the background you will hear the Non-Secure Warning Tone every 8 seconds as a reminder.

APPENDIX C

ABBREVIATED INSTRUCTIONS

(Representative Example)

Your Telephone Number: 954

TELEPHONE INSTRUCTIONS

Making A Normal Call: Remove receiver, wait for dial tone, then firmly depress one key at a time for desired number.

Precedence Calls: (YOUR AUTH LEVEL ___)

Key "P" for Priority
"I" for Immediate
"F" for Flash
"FO" for Flash Override
→ Then key desired number

Calls of a high precedence preempt other calls in progress of a lower precedence as necessary. If you hear a preempt tone you should wait either for an incoming preempt call (you are the desired party) or to hear silence (you are not the desired party). . .in the latter case you should hang up.

Operator Assistance:

During call– Key "CR" for Recall
Other times– Key "O"

Progressive Conferencing: Key "C"; upon receiving 2nd dial tone, key number of first conferee. Repeat process for each additional conferee. To cancel a keying mistake or release unanswered numbers, key "R."

Preprogrammed Conferencing: (GROUP 351)

Key "C" followed by your conference group number. To release unanswered numbers, key "R."

Conferees are notified of an incoming conference call by a short tone burst after lifting the receiver.

Broadcast Conferencing: (GROUP 171)

Same procedure as preprogrammed conferencing.

Call Transfer:

Key "3R"; upon receiving 2nd dial tone, key number to which you desire your calls to be forwarded. To cancel call transfer, key "3R" and then your number (this must be done from the telephone at which it was initiated).

Warning: Do not discuss classified information when calling over a non-secure circuit. You will be warned that this condition exists by a short "beep" tone given at 8-second intervals during the call.

Plain Text Alert: You have entered a non-secure circuit. DO NOT DISCUSS CLASSIFIED INFORMATION

APPENDIX D

LIST OF POSSIBLE ANSWERS
(Representative Examples)

H A N G U P

112 HANG UP. . .the trunks are busy

111 HANG UP. . .the number called (line) is busy

110 HANG UP. . .something is busy — (either the line, the trunks, or the special service requested--you don't know which)

113 HANG UP. . .the special service request is busy — (either call transfer, recall, broadcast conference or preprogrammed conference--you don't know which)

121 HANG UP. . .you have made a mistake — (either you keyed the wrong digits, attempted to use a service not authorized on your phone, or hung up your phone improperly--you don't know which)

120 HANG UP. . .a fault or mistake exists — (either you made a mistake or the system needs repairs--you don't know which)

122 HANG UP. . .an equipment fault exists

100 HANG UP. . .Uncertain — (it is one of the reasons above, but you're not sure which)

H A N G U P

W A I T

222 WAIT. . .for an incoming broadcast conference call

221 WAIT. . .for an incoming preprogrammed conference call

220 WAIT. . .for an incoming conference call — (either for a broadcast conference call or a preprogrammed conference call--you don't know which)

230 WAIT. . .and determine nature of preemption — (you just received a preempt signal, wait to see if the call is for you)

210 WAIT. . .for the called party or operator to answer

200 WAIT. . .uncertain — (it's one of the reasons above, but you're not sure which)

W A I T

CONTINUE

310 CONTINUE keying. . .in the desired party (NOT call transfer)

320 CONTINUE keying. . .in the desired party (BUT you have been warned that call transfer is still in effect)

300 CONTINUE keying. . .in the desired number (BUT you aren't sure if the best answer is 310, 320, or 330)

330 CONTINUE keying. . .in the desired call transfer number (call transfer service has been approved and you continue by keying in the desired call transfer address)

420 CONTINUE (conferee disconnect warning). . .you've been warned that a conferee has just hung up (you are in a conference call)

410 CONTINUE (non-secure warning). . .you are being warned that this call is not secure (do not discuss any classified information)

400 CONTINUE. . .uncertain (it's one of the reasons above, but you're not sure which)

430 CONTINUE (plain text alert)

CONTINUE

APPENDIX E

ANSWER SHEET

(Representative Example)

ANSWERS	POINTS
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____
11. _____	_____
12. _____	_____
13. _____	_____
14. _____	_____
15. _____	_____
16. _____	_____
17. _____	_____
18. _____	_____
19. _____	_____
20. _____	_____
21. _____	_____
22. _____	_____
23. _____	_____
24. _____	_____
25. _____	_____
26. _____	_____
27. _____	_____

S NO.→ _____

TOTAL PTS.→ _____

DATE → _____
COND.→ _____
RUN → _____
SCORE→ _____
1 2

APPENDIX F

QUESTIONNAIRE

(Representative Example)

Participant No. _____

1. Educational background—highest educational level completed (circle one):

8 years or less	13 years	17 years
9-10 years	14 years	18 years
11 years	15 years	19 years
12 years	16 years	20 + years

2. Are you a high school graduate? (Check one)

_____ Yes

_____ No

3. Are you a college graduate? (Check one)

_____ Yes

_____ No

4. Which set of instructions did you use most frequently? (Check one)

_____ Brief (1 page)

_____ Detailed (4 pages)

Why? (Explain your answer)_____

_____

_____

_____

5. Rate each tone and tone condition in the system in terms of its overall effectiveness. Take into account how easy or difficult it was to learn, as well as how it helped you to use the system as a whole. Circle the <u>one</u> number which best describes each tone.

	Very Poor	Barely Acceptable	Not Quite Good	Moderately Good	Very Good In Most Respects	Extremely Good
Dial Tone	1	2	3	4	5	6
Normal Ringback	1	2	3	4	5	6
Converter Ringback	1	2	3	4	5	6
Line Busy	1	2	3	4	5	6
Trunk Busy	1	2	3	4	5	6
Error	1	2	3	4	5	6
Lockout	1	2	3	4	5	6
Recall	1	2	3	4	5	6
Conferee Disconnect	1	2	3	4	5	6
Broadcast Conference	1	2	3	4	5	6
Preprogrammed Conference	1	2	3	4	5	6
Trunk Busy After Call Transfer Request	1	2	3	4	5	6
Preempt Followed by Line Busy	1	2	3	4	5	6
Call Transfer Dial Tone After Going Off-Hook	1	2	3	4	5	6
No Tone After Recall Request	1	2	3	4	5	6
Normal Ringback After Preprogrammed Conference Request	1	2	3	4	5	6
Preempt	1	2	3	4	5	6
Preempt During Conference	1	2	3	4	5	6

6. Which three tones did you find most difficult?

____ a.

____ b.

____ c.

Why? (Explain your answer)

a. _____

_____

b. _____

_____

c. _____

_____

7. Please give any other comments about problems that you encountered in learning this system and any suggestions that you have for its improvement.

_____

_____

_____

_____

_____

_____

_____

_____

APPENDIX G

DETAILED DATA ANALYSIS

CONTENTS

TABLE 1G

Tone Analysis by Ss (Analog Group)

Tones	Participant Number						
	#15	#14	#13	#4	#16	#1	$\overline{X}$
Dial Tone	5	6	6	6	6	4	5.50
Normal Ringback	5	6	6	6	6	4	5.50
Converter Ringback	4	6	4	5	3	4	$4.\overline{33}$
Line Busy	3	6	5	4	5	5	$4.\overline{66}$
Trunk Busy	3	5	5	3	5	2	3.83
Error	5	6	6	3	6	3	4.83
Lockout	5	6	6	6	6	3	5.33
Recall	5	5	5	6	4	2	4.50
Conferee Disconnect	2	2	2	1	5	2	$2.\overline{33}$
Broadcast Conference	4	1	2	1	5	2	2.50
Preprogrammed Conference	4	1	2	3	3	2	2.50
TB After CTR	5	3	5	6	4	4	4.50
Preempt Followed by LB	5	5	5	6	4	5	5.00
CTDT After Off-hook	6	4	3	4	3	4	4.00
No Tone After Recall Request	4	2	1	3	5	2	2.83
Normal R After Preprogrammed Conference Request	4	6	4	1	4	4	3.83
Preempt	4	4	3	3	6	3	3.83
Preempt During Conference	3	2	4	3	6	3	3.50

TABLE 2G

Tone Analysis by Ss (Digital Group)

Tones	Participant Number						
	#18	#6	#10	#20	#17	#21	$\bar{X}$
Dial Tone	5	6	6	4	4	5	5.00
Normal Ringback	2	5	6	6	4	5	$4.\overline{66}$
Line Busy	2	4	3	5	3	5	$3.\overline{66}$
TB After CT Request	2	4	3	2	4	1	$2.\overline{66}$
Preempt Tone	5	3	1	3	4	2	3.00
No Tone After Recall Request	5	5	3	6	1	6	$4.\overline{33}$
Broadcast Conference Notification Tone	5	3	2	5	1	2	3.00
Conferee Disconnect Tone	5	3	5	4	1	2	$3.\overline{33}$
Preempt During Conference	4	4	6	4	5	2	4.16
Digital Ringback	4	5	6	6	4	5	5.16
Preprogrammed Conference Notification Tone	2	3	2	4	1	2	2.33
Non-secure Warning	5	6	6	6	5	5	5.50
Alarm Tone	5	2	6	6	2	6	4.50
Converter Ringback	5	6	5	6	2	5	4.83
Recall Tone (Ringback)	5	3	6	6	4	5	4.83
CTDT After CT Request	4	3	5	5	1	2	3.33
Error Tone	5	2	5	5	2	6	4.16
CTDT After Going Off-hook	2	3	5	5	2	3	3.33
Trunk Busy Tone	2	3	4	6	1	5	3.50

TABLE 3G

Tone Analysis by Ss (DOD Group)

		Participant Number						
		#5	#7	#9	#11	#19	#3	$\overline{X}$
Tones	Dial Tone	6	6	5	5	5	6	5.50
	Normal Ringback	6	6	5	6	5	6	$5.\overline{66}$
	Line Busy	6	6	4	6	5	6	5.50
	Preempt Tone (Busy)	6	6	4	6	5	5	$5.\overline{33}$
	Non-secure Warning	6	6	6	6	5	5	$5.\overline{66}$
	Recall Tone (Ringback)	6	5	5	6	5	6	5.50
	CTDT After CT Request	6	6	5	6	5	4	$5.\overline{33}$
	Error Tone	6	4	2	6	5	4	4.50
	Ringback After PC Request	5	4	4	6	6	5	5.00
	Plain Text Alert Tone	5	4	2	5	6	3	4.16
	Announcements:							
	Out of Service	5	6	6	6	6	6	5.83
	Unassigned Number	5	6	6	6	6	6	5.83
	Restricted Area	5	6	6	6	6	6	5.83
	Precedence Exceeded	5	5	5	6	6	6	5.50
	Conference Notification	5	6	6	6	6	6	5.83
Most Difficulties		PTA -	PTA Error	- -	PTA DT After CT Req	LB TBCT	PTA Error Recall	

TABLE 4G(a)

Summary Data—Tones by Condition of Treatment (Percent Correct)

	Tone Situation Number																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Summary data: tones across Ss	91.5	86.4	86.4	82.6	82.0	69.9	91.2	72.7	65.0	82.5	90.1	81.7	57.9	75.4	77.9	77.8	60.7	67.6
	BASIC																	
Collapsed Matrix: Analog, Digital, DOD	85.2	80.7	87.1	70.4	70.9	57.9	83.6	66.9	67.0	74.5	88.2	82.1	--	--	--	--	--	--
	FULL - SERVICE																	
	91.8	92.2	85.7	90.6	91.7	79.0	99.5	78.1	63.5	90.6	91.7	81.3	57.9	75.4	77.9	77.8	60.7	67.6
Collapsed Matrix Along Basic-Full Dimensions																		
Analog	94.1	87.3	88.1	91.1	89.4	94.1	91.2	80.7	70.3	82.5	100.0	72.7	75.0	84.8	84.9	82.2	70.0	73.6
Digital	88.8	86.9	83.6	76.3	69.0	64.1	--	62.3	71.1	--	87.7	84.4	45.5	78.8	65.0	68.6	40.9	55.7
DOD	90.6	83.3	--	77.6	--	--	--	70.8	--	--	--	--	--	--	--	--	--	--

TABLE 4G(b)

Summary Data—Tones by Condition of Treatment
(Percent Correct)

	Tone Situation Number																
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Summary data: tones across Ss	90.6	52.9	86.5	74.3	90.4	60.5	90.0	87.1	100.0	98.4	98.4	82.3	80.0	91.9	100.0	93.5	93.3
	BASIC																
Collapsed Matrix: Analog, Digital, DOD	--	--	62.1	--	86.0	31.6	79.3	--	--	--	--	--	66.1	--	--	--	--
	FULL																
	90.6	52.9	93.3	74.3	94.6	74.1	100.0	87.1	100.0	98.4	98.4	82.3	93.8	91.9	100.0	93.5	93.3
Collapsed Matrix Along Basic-Full Dimensions																	
Analog	92.5	61.4	98.6	77.1	90.1	--	--	--	--	--	--	--	--	--	--	--	--
Digital	89.7	34.8	82.4	68.2	--	51.2	100.0	76.9	100.0	100.0	100.0	100.0	85.7	88.5	100.0	91.6	99.3
DOD	--	--	62.1	--	--	66.7	87.2	94.4	100.0	97.2	97.2	69.4	78.4	94.4	100.0	94.9	88.9

TABLE 5G(a)

Tones by Condition and Level of Treatment

		Tone Situation Number																	
Tone Situation Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Phase I	(BA)	87.2	80.5	82.5	80.2	78.3	--	83.6	68.2	57.5	74.5	--	--	--	--	--	--	--	--
	(BD)	86.0	85.8	93.4	53.9	60.5	57.9	--	63.8	80.3	--	88.2	82.1	--	--	--	--	--	--
	(B DOD)	79.3	73.9	--	75.9	--	--	--	68.8	--	--	--	--	--	--	--	--	--	--
Phase II	(FA)	97.7	93.0	92.6	98.6	97.9	94.1	99.5	90.9	80.0	90.6	--	--	75.0	84.8	84.9	82.2	70.0	73.6
	(FD)	90.4	87.9	71.9	90.7	78.8	71.2	--	61.0	63.3	--	87.1	87.1	45.5	78.8	65.0	68.6	40.9	55.7
	(F DOD)	96.3	100.0	--	78.7	--	--	--	74.2	--	--	--	--	--	--	--	--	--	--

TABLE 5G(b)

Tones by Condition and Level of Treatment

Tone Situation Number	Tone Situation Number 19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Phase I (BA)	--	--	--	--	86.8	--	--	--	--	--	--	--	--	--	--	--	--
(BD)	--	--	--	31.6	--	--	--	--	--	--	--	--	--	--	--	--	--
(B DOD)	--	--	62.1	--	84.5	--	79.3	--	--	--	--	--	66.1	--	--	--	--
Phase II (FA)	92.5	61.4	98.6	77.1	93.4	--	--	--	--	--	--	--	--	--	--	--	--
(FD)	89.7	34.8	82.4	68.2	92.3	67.4	--	--	--	--	--	--	--	--	--	--	--
(F DOD)	--	--	--	--	100.0	66.7	100.0	94.4	100.0	97.2	97.2	69.4	100.0	94.4	100.0	94.9	88.9

TABLE 6G(a)

Questionnaire Analysis (Analog Group)

		#15	#14	#4
Highest Ed. Level Completed (Yrs)		12	14	13
H.S. Grad?		Yes	Yes	Yes
College Grad?		No	No	No
Which Instructions?				
Brief?			X	
Detailed?		X		X
Why?		For the difficult sounds and lengths of tones.	I needed the reference to the numbers to answer the questions.	Explain most of question for answer in the (1?) page.
Which tones most difficult?	(a)		Broadcast/preprogrammed conference.	Broadcast conference.
	(b)		Too similar to other tones & also irritating & loud. Would disturb the conference.	When pick up the phone sometimes miss the tone.
	(c)		Too similar to other tones.	
General Comments:			I think the whole system is too complicated & somewhat impractical for everyday use.	

TABLE 6G(b)

Questionnaire Analysis (Analog Group)

		#13	#16	#1
Highest Ed. Level Completed (Yrs)		12	12	12
H.S. Grad?		Yes	Yes	Yes
College Grad?		No	No	No
Which Instructions?				
Brief?				
Detailed?		X	X	X
Why?		Because it told the answer and how to use the telephone.	It brought out the answer (more) clearly than the brief.	You can't follow the short brief and make the best choice at first, but as you progress and learn all tones then sheets aren't necessary.
Which tones most difficult?	(a)		No T after recall request	
	(b)		Preprogrammed conference	
	(c)		Converter R	
Explain	(a)			Conferee disconnect and conferee notification are hard to distinguish.
	(b)			Incoming preprogrammed conference calls and broadcast conference calls are hard to distinguish between.
General Comments:				There are too many tones that sound alike & if you aren't paying close attention then you will be hanging up when you should be listening or speaking. The insecure line warning tone is the best one & the one that is most important for phone usage.

TABLE 7G(a)

Questionnaire Analysis (Digital Group)

		#21	#17	#20
Highest Ed. Level Completed (Yrs)		16	12	11
H.S. Grad?		Yes	Yes	No
College Grad?		Yes	No	No
Which Instructions?				
Brief?				
Detailed?		X	X	X
Why		Detailed instructions gave directions on what to do in each situation.	More Info	To fully understand the operation of the tones.
Which tones most difficult?	a)	Preempt/Conferee disconnect	Trunk & LB	Transfer Disconnect
	b)	Broadcast/Preprogrammed	Broadcast & Preempt	Plans Test Alert
	c)		Ringback	Call Transfer
Explain	a)	These tones are so closely related it is difficult to distinguish them. They are related in sound as well as situation.	TB & LB similar. What difference does it make?	They just didn't seem to come as easy.
	b)		Too close together.	
	c)		Too many	
General Comments		There should only be a need for a dial tone, a NSW tone, and then one other tone in each general situation (hang up, wait, continue). These would suggest that you do one of the three.		None

TABLE 7G(b)

Questionnaire Analysis (Digital Group)

		#10	#6	#18
Highest Ed. Level Completed (Yrs)		12	9-10	12
H.S. Grad?		Yes	No	Yes
College Grad?		No	No	No
Which Instructions?				
Brief?				X
Detailed?		X	X	
Why?		More Info.	They help me learn the system better.	I could understand it better when the instructor explained it right.
Which tones most difficult?	(a)	Conferee (dropout)	Broadcast Conference	Preempt during Conference.
	(b)	Broadcast Conference	Preprogrammed	Preprogrammed Notification
	(c)	Preempt	Preempt during call	CTDT-CTR
Explain	(a)	They all sound alike.	They were hard to learn.	Sound so much like conferee disconnect.
	(b)			Sound like preempt.
	(c)			Sounds so much like a normal dial tone & I keep forgetting its a transfer call.
General Comments:		--	Lots of tones sounded the same.	--

TABLE 8G(a)

Questionnaire Analysis (DOD Group)

		#11	#9	#3
Highest Ed. Level Completed (Yrs)		13	12	12
H.S. Grad?		Yes	Yes	Yes
College Grad?		No	No	No
Which Instructions?				
Brief?		X		X
Detailed?			X	
Why?			Because it was hard to catch on to.	It was easy enough I just had to use brief.
Which tones most difficult?	(a)	PTA	--	PTA
	(b)	DT after CT request		Error
	(c)			Recall
Explain	(a)			Tone was too difficult to learn. (Tone should have been announcement).
	(b)	Same as regular dial tone.		
	(c)			It is hard to remember the digits you have to dial.

TABLE 8G(b)

Questionnaire Analysis (DOD Group)

		#7	#5	#19
Highest Ed. Level Completed (Yrs)		11	9/10	13
H.S. Grad?		No	No	Yes
College Grad?		No	No	No
Which Instructions:				
Brief?		X	X	X
Detailed?				
Why?				
Which tones most difficult?	(a)	PTA	PTA	LB
	(b)	Error		TB after CT request.
	(c)			
Explain	(a)	I kept getting it mixed up with error tone.	PTA & error sounded a lot like each other.	Line busy trunk busy sounded the same.
	(b)			
	(c)			
General Comments:		No problems learning the system.		

TABLE 9G

Scores Per Trial (Participants x Levels) Analog Condition

		Trial Number													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Basic Analog (Criterion 133)															
Participant #	4	42	94	146	124	146	136								
	13	84	64	111	121	124	144	124	146	148					
	1	111	82	92	137	119	126	146	112	120	120	124	127	146	146
	15	77	86	136	124	126	136	148							
	16	30	10	47	56	76	96	126	136	150					
	14	67	42	126	104	111	126	126	148	148					
Full Service Analog (Criterion 247)															
Participant #	4	205	232	236	248	264									
	13	189	194	214	228	246	262	235	268	257					
	1	153	203	221	248	247									
	15	195	184	227	244	258	244	246	268	268					
	16	153	176	186	212	206	264	244	205	217	217	238	257	255	
	14	194	164	203	228	245	228	215	244	255	235	265	254		

TABLE 10G

Scores Per Trial (Participants x Levels) Digital Condition

		Trial Number													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Basic Digital (Criterion 152)															
Participant #	18	39	45	47	104	66	104	116	116	128	128	128	156	156	
	6	92	139	99	126	124	131	154	156						
	10	77	59	55	69	86	148	112	136	158	168				
	20	70	111	104	129	109	116	124	138	166	151	168	168		
	21	84	101	119	136	128	148	168	168						
	17	97	111	122	134	112	158	156							
Full Digital (Criterion 266)															
Participant #	18	187	256	208	203	232	235	222	225	247	288	274			
	6	196	219	214	275	273									
	10	187	178	204	240	236	223	272	286						
	20	216	177	234	122	223	223	238	287	270					
	21	198	225	260	255	272	266								
	17	193	203	236	234	218	266	252	277	277					

TABLE 11G

Scores Per Trial (Participants x Levels) DOD Condition

	Trial Number										
Basic DOD (105)	1	2	3	4	5	6	7	8	9	10	11
9	12	10	15	22	70	15	55	65	100	112	112
19	85	62	77	87	97	112	112				
7	72	70	100	90	100	112	112				
3	80	102	112	112							
5	87	112	112								
11	92	110	112								
FS DOD (285)											
9	267	265	290	295							
19	250	281	292	290							
7	235	275	290	302							
3	272	294	302								
5	260	250	282	304	292						
11	270	284	394	302							

TABLE 12G

Scores Per Trial (Participants x Treatments) Crossover Condition

FD (B)
to FDOD (C)

Crit = 285	Trial Number 1	2	3	4	5	6	7	8	9	10
17	282	302	302	--	--	--	--	--	--	--
21	302	302	--	--	--	--	--	--	--	--
20	282	292	297	--	--	--	--	--	--	--
16	291	302	--	--	--	--	--	--	--	--
18	277	292	292	--	--	--	--	--	--	--
10	276	281	302	302	--	--	--	--	--	--

FA
to FD

Crit 266	1	2	3	4	5	6	7	8	9	10
4	272	267	--	--	--	--	--	--	--	--
13	256	285	276	--	--	--	--	--	--	--
1	220	266	276	--	--	--	--	--	--	--
16	257	232	278	278	--	--	--	--	--	--
15	266	287	--	--	--	--	--	--	--	--
14	252	266	273	--	--	--	--	--	--	--

TABLE 13G(a)

ANOVA Summary

ANALYSIS OF VARIANCE

AB Matrix (Sums)

Treatments (Tone Combinations)

Levels	(A) A_1	(D) A_2	(DOD) A_3	SUM
(Basic) B_1	54	57	36	147
(Full) B_2	53	48	24	125
SUM	107	105	60	272

ABS Matrix (Individual Observations)

Treatment Combinations

ab_{11}	ab_{12}	ab_{21}	ab_{22}	ab_{31}	ab_{32}
6	5	12	11	11	4
9	9	8	5	7	4
14	5	10	8	8	4
7	9	12	9	4	3
9	13	8	6	3	5
9	12	7	9	3	4

$(ABS)^2 = 2388$

TABLE 13G(b)

ANOVA Summary

AB Matrix (Means)

	Factor A		
Factor B	a_1	a_2	a_3
b1	9.00	9.50	6.00
b2	8.83	8.00	4.00

$T = \frac{T^2}{abs} = 2055.11$ $B = \frac{(A)^2}{bs} = 2068.55$ $A = \frac{(B)^2}{as} = 2172.83$

$AB = \frac{(AB)^2}{s} = 2191.66$ $ABS = (ABS)^2 = 2388$ $S = 6$

Summary of the Analysis

Source	Calculations	SS	df	MS	F
A	2171.83-2055.11	117.72	2	58.86	8.99**
B	2068.55-2055.11	13.44	1	13.44	2.05
AXB	2191.66-2172.83-2068.55+2055.11	5.39	2	2.70	.41
S/AB	2388-2191.66	196.34	30	6.55	

**$p < .001$